Technical designs for research vessel Aurora Borealis unveiled

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The technical designs for the first state-of-the-art Arctic research vessel, the Aurora Borealis, were presented this week in Berlin by Germany's Alfred Wegener Institute for Polar and Marine Research and engineering company Wärtsilä Ship Design Germany. The heavy icebreaker, which will serve as a scientific drilling ship and multi-purpose research platform, has been designed with new technology that will allow it to operate year-round in all polar waters.

The technical design and planning of Aurora Borealis was granted EUR 5.2 million by the German Federal Ministry for Education and Research and EUR 4.5 million through the EU-funded ERICON ('European research icebreaker consortium') project. ERICON comprises 15 members from 10 European nations including Norway and the Russian Federation, and is financed under the Seventh Framework Programme's Environment Theme.

Designing the Arctic research vessel was a challenge because the ship needs to break pack ice, maintain very accurate positioning and execute repairs in a remote region. Technical specifications for the Aurora Borealis had to take into account the need for drilling in deep waters, data collection and on-board laboratories at times when the Arctic region is seemingly impossible to visit (late autumn, winter and early spring).

According to Lester Lempke, an engineer working on the project, the designers had to develop an easily serviceable and manageable concept for operation, repair and maintenance in a remote area. Existing technologies used by ships drilling for oil were not robust enough for the Arctic; water and ice do not exert the same kind of forces against a ship's hull. 'We saw immediately that the technology wasn't advanced enough for ice,' he said.

The engineers designed a specialised, balcony-shaped hull with a novel adaptation at the water line, Mr Lempke explained to CORDIS News. The hull needed a specific 'shoulder' and sides that would break the ice sideways, and withstand the crushing pressure of the ice. Aurora Borealis will have a mechanically robust hull made with high-grade steel that has an optimised shape at the water line.

The other innovation is the adaptation of propellers and thrusters on the ship. These devices need to be robust and precise, and set in bays so that they can be retracted in dangerous conditions or simply for repairs and maintenance. Propellers are placed aft and several transverse thrusters are positioned at the front and sides of the vessel. Each thruster is 4.6 metres in diameter and requires 4.5 megawatts of propulsion power.

The Aurora Borealis design features two 'moon pools', from which research vessels or drilling equipment can be deployed from inside the ship, measuring seven by seven metres. The moon pools are shaped like continuous vertical funnels, from deep within the hull into the water below. Lowering the equipment from inside the ship helps the researchers avoid the hazards of wind, waves and ice. For the first time, very sensitive and expensive equipment, for example remotely operated or
autonomous underwater vehicles, will be able to enter the waters beneath the ice pack.

Laboratories are planned on the several decks around the moon pool, but containerised laboratories can be also be loaded onto the vessel and become fully integrated into the scientific workflow on board.

The new hull shape, propulsor positioning and design underwent a series of trials in the ice tanks of the Hamburg Ship Model Basin in Germany and at Aker Arctic in Helsinki, Finland. The extensive testing has proven that the Aurora Borealis is indeed able to position itself dynamically in ice cover over two metres thick.

The new vessel also has extremely high safety and redundancy in the engine room and in its electrical system. The most important factor to consider when designing this important ship is that it will be exploring very remote regions and is made of very heavy parts: it will be far from shipyards and will need to service itself.

Scientific drilling in the Arctic Ocean is crucial for filling in large gaps in climate change data. The drilling rig of the Aurora Borealis will allow drilling more than 1,000 metres into the sea floor, in water that is 100 to 5,000 metres deep. The dynamic positioning system of the ship, novel in its ability to manoeuvre the ship in drifting pack ice, will make drilling and scientific research in this extreme environment possible.

It is important to conduct year-round scientific observations in order to understand the dynamic systems of the polar regions. The Aurora Borealis is well on its way to answering questions about the geological history and climate of the Arctic Ocean. The 60 scientists involved in the planned international research expeditions also hope to measure the transport of contaminants through the air, water and ice; in this way they hope to quantify the effects of human activity on the Arctic environment.

The Aurora Borealis was included in the priority list of the European Commission’s European Strategy Forum on Research Infrastructures.

Source: Alfred Wegener Institute and CORDIS News interview with Lester Lempke

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